NOTES ON THE GENUS *CAECULISOMA* (ACARINA: ERYTHRAEIDAE) WITH COMMENTS ON THE BIOLOGY OF THE ERYTHRAEOIDEA

by R. V. Southcott

[Read 13 October 1960]

SUMMARY

The larva of the genus *Caeculisoma* Berlese, 1888, is defined from the rearing of a larval species *C. darwiniense* n. sp. to the nymphal stage. Larvae were captured parasitic upon the locust *Goniaea* sp. aff. *hyalina* Sjöstedt at Coomalie Creek, Northern Territory. The larva, pupa I and nymph are described, and figures given. The nymph is compared with previously known adults or nymphs.

Mites answering to *Caeculisoma clavigerum* Canestrini, 1897, are recorded from the Aitape-Wewak region of New Guinea; this is the first occasion on which this species has been possibly identified since the original record. *Caeculisoma argus* ssp. *to* n. ssp. is recorded from South Australia.

The biology and distribution of *Caeculisoma* is discussed. It is pointed out that the wide geographical distribution of the genus is at least partly explicable on the grounds of dispersion of larvae parasitic upon locusts and grasshoppers.

A comparison is made between the annual cycles of life histories of various Australian Erythraeoidea. It is shown that two broad classes are distinguishable in temperate Australia, these being the long-duration-egg class (I) and the short-duration-egg class (II). In class I the animal passes about 2/3 of the annual cycle as the egg (including deutovum), and the other instars are fairly short. The larva hatches from spring to early summer, the animal passing through successive instars to the adult stage by the summer, with oviposition in general from mid- to late summer. In class II the animal passes about 1/3 of the annual cycle in the egg, and the successive instars are comparatively long. Oviposition is in early summer, and the larvae occur over the autumn (March-May). Some variation occurs to the above general patterns, which are tabulated and commented upon.

INTRODUCTION

The writer has recently defined the characters of the larva of the genus *Caeculisoma* Berlese, 1888, in his monograph on the genera of the Erythraeoidea (1961). That definition was based upon the rearing of an undescribed larval Erythraeoid mite to the nymphal stage in 1943, specimens of the mite having been taken parasitic upon a species of locust at Coomalie Creek, Northern Territory. From that definition it was apparent that no previous larvae of *Caeculisoma* had been described.

In the present paper the species concerned is described as *C. darwiniense* n. sp. from the larva, pupa I and nymph. The species is compared, in the nymphal stage, with previously described adults (or possibly nymphs) of *Caeculisoma*. Some reference will be made to other species of the genus, both from the systematic and distribution aspects.

A comparison will be made between the annual life cycles of various Erythraeoidea, and the present knowledge of the durations of the various stages, and some general conclusions drawn.

DESCRIPTION* OF A NEW AUSTRALIAN SPECIES

Caeculisoma darwiniense n. sp.

Figs. 1-4

Description of Larva (Figs. 1, 2) (from the holotype ACA1062B; also supplemented where indicated from the paratype specimen ACA1062A): Colour in life, red. Length of idiosoma (unengorged), 290μ, width, 220μ; animal, 415μ long to tip of cheliceral blades. Idiosoma the usual ventrally flattened elongate spheroid.

Dorsal scutum as figured, oval with anterior margin flattened, slightly concave; anterolateral angles rounded; posteriorly produced into two flattened projections in relation to the posterior sensillae, with a shallow notch between them. Shield laterally convex; slightly concave posterolaterally at the level of the PSens.

The Standard data in micra of the type and paratype are as follow:

Specimen	ACA1062B (holotype)	ACA1062A (paratype)
AW	83·5	85
MW	87	90
PW	77	78
SBa	8	9
SBp	15	15
ASB	34	30
ISD	47	48
L	87	88
W	97	105
A—M*	19	18
A—P	44	43
AL	41	43
ML	43	46
PL	34	33
ASens	41	40
PSens	75	68
ASB/ISD	·72	·67
DS	26—51	31—55

* Distance between centres of AL and ML scutalae; equivalent to A—P, but using the second row of scutalae instead of the posterior pair.

Scutalae of medium size, lightly curved, with fine adpressed barb-like ciliations, the setae terminally blunted; AL and ML setae of about the same thickness, PL a little thinner. AL setae arise near the anterolateral angles of the shield; ML posterior and slightly lateral to AL; PL scutalae arise near the edges of the shield, and as the shield narrows posteriorad the PL scutalae are slightly medial to ML.

Scutal sensillae are fine, tapering, pointed, very lightly ciliated (under oil immersion). ASens arise a little (about 8μ) behind the ML scutalae. PSens arise about 5μ anterior to posterior end of shield.

Eyes one on each side, circular, lenses 14μ across, and situated in the unengorged specimen between the levels of the PL scutalae and the PSens.

* For the technical descriptive terms used and the definitions of the "Standard data" the writer's account (1961) should be referred to.

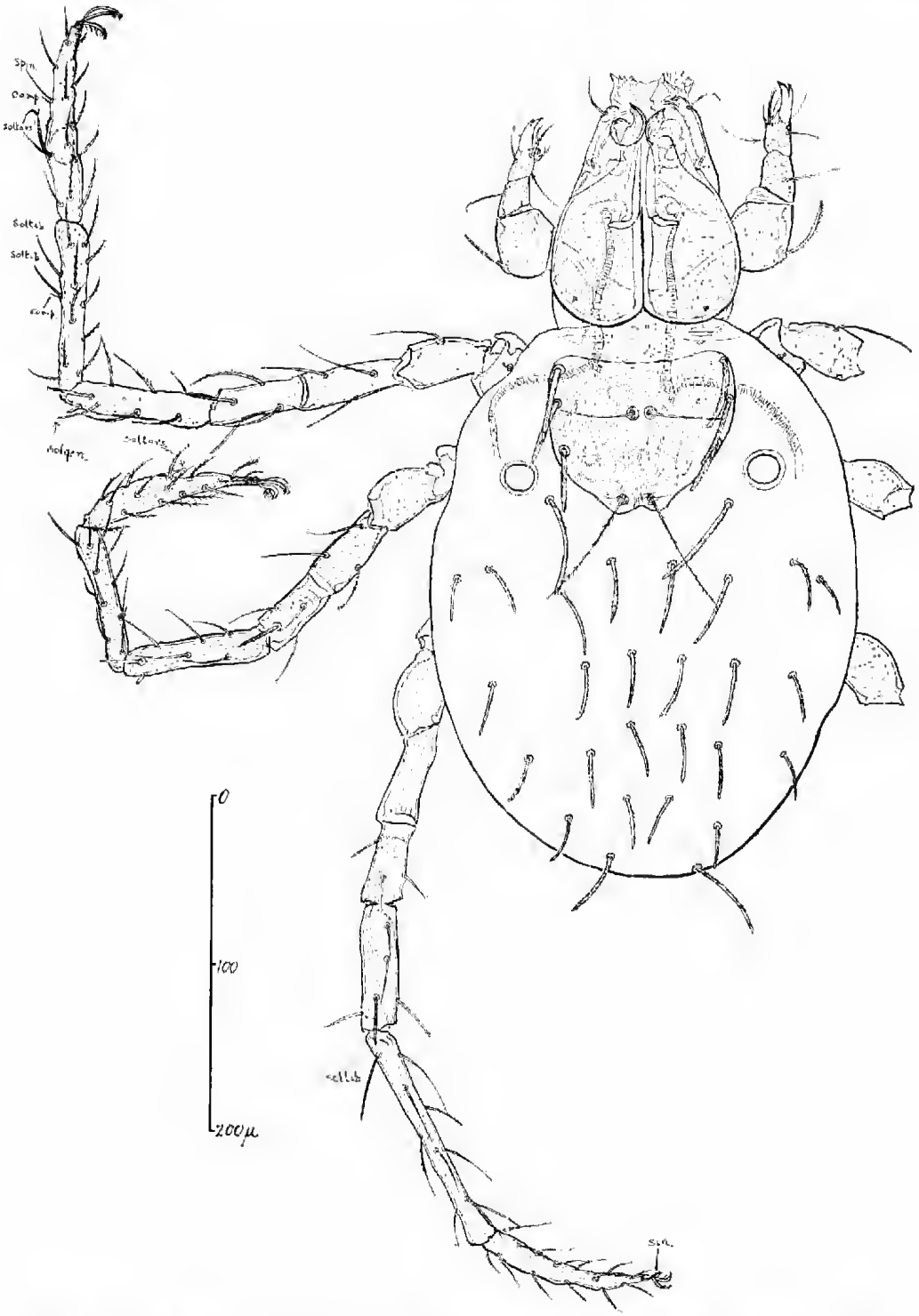

Fig. 1.—*Caeculisoma darwiniense* n. sp. Larva, dorsal view of holotype. The tracheae are also shown, and some of the internal structure of the gnathosoma. Lettering shows the sensalae of the legs: *comp.* companala, *sin.* sinuala, *solgen.* solenogenuala, *soltars.* solenotarsala, *soltib.* solenotibiala, *spin.* spinala.

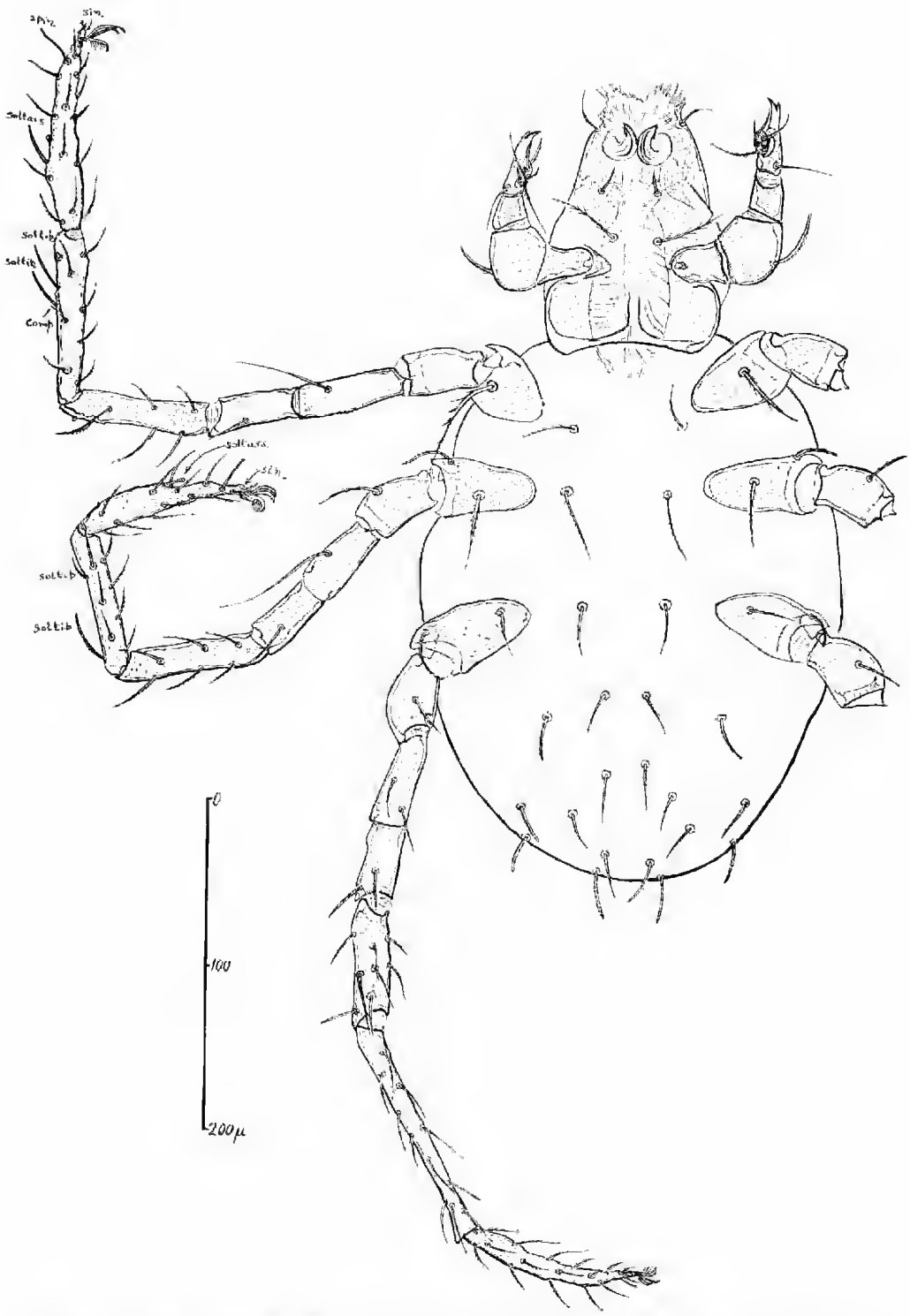

Fig. 2.—*Caeculisoma darwiniense* n. sp. Larva, ventral view of holotype. Some of the internal structure of the gnathosoma is shown. Sensalae of the legs lettered as in Fig. 1. (In general, as in previous illustrations, an effort has been made to distinguish in Figs. 1 and 2 between the dorsal and ventral setae, in the limbs as well as elsewhere, but where a seta, particularly a sensala, is so placed that its seta base is visible from both sides, it may be shown in both the dorsal and the ventral views.)

Dorsal idiosomalae similar to scutal scobalae, lightly curved, parallel-sided or slightly tapering (blunted terminally), with fine adpressed barbed ciliations along the convex side, a few more outstanding barbs being present distally along the concave side; arranged 2 (ocular row), 8, 6, 6, 4, 2; total 28. The ocular setae are the largest of the dorsal idiosomalae; the setae next in size are only 41μ long (type) or 44μ (paratype); the smallest dorsal setae are the 5 lateral setae down each side (see Fig. 1).

Venter: between coxae I a pair of scobalae (sternalae), fairly short, pointed, ciliated, 30μ long; between coxae II a similar pair, but stronger and longer, 36μ long; between coxae III a similar pair, 31μ long; behind coxae III, on the ventral opisthosoma, are similar setae, which gradually change in character posteriorad, to approximate those of the posterior pole of the idiosoma dorsally, arranged 4, 2 + 5 + 2, 1 + 2 + 1; 22-30μ long.

Coxal formula 1, 2, 2. Coxala I strong, pointed, ciliated, 40μ long. Medial coxala II pointed, slightly ciliated, 32μ long; lateral coxala II curved, blunted, ciliated, 20μ long. Medial coxala III similar to II, 28μ long; lateral coxala III curved, somewhat pointed, ciliated, 20μ long. Supracoxala present to coxa I, normal, peg-like, 4μ long.

Legs normal for family: I 520μ long, II 455μ, III 535μ (all lengths including coxae and claws). Each trochanter with one seta (trochanterala, a scobala). Tarsi tapering, with irregularities, as figured. The femur-tibia segments more or less cylindrical. Tarsus I 104μ long (excluding claws and pedicle) by 18μ high. Tibia I 102μ long. Tarsus III 104μ long (without claws and pedicle) by 15μ high. Tibia III 143μ long.

On the legs the following is the arrangement of the specialized setae:

	trichobothrialae (sensillae)	solenoidalae (solenidia)	spinalae (eupathidies)
genu I	0	1	0
genu II	0	0	0
genu III	0	0	0
tibia I	0	2	1 (comp.*)
tibia II	0	2	0
tibia III	0	1	0
tarsus I	0	1	4 (1 dorsal 1 subterminal 1 comp. 1 ped.**)
tarsus II	0	1	1 (ped.**)
tarsus III	0	0	1 (ped.)

* companala, accompanying the posterior solenoidala.

** the spinala alongside the pedicle. This has been named the pretarsala in the trombiculid system of nomenclature. Newell (1957 p. 407) finds this term unacceptable, "a misnomer". Possibly "sinuala", here proposed, is an acceptable term; these setae are characteristically sinuous.

The scobalae of the legs do not in general show a high degree of differentiation. Trochanteral formula 1, 1, 1; basifemoral 4, 4, 2; telofemoral 5, 5, 5.

Tarsal claws: anterior strong, nearly straight with strong terminal ventrally directed hook, unciliated; middle claw falciform, more slender; posterior claw strong, falciform, with long ventral ciliations.

Gnathosoma as figured. Chelae bases ("mandibles") form a compact cordate mass, with finely punctate chitin. Chelicera blades rounded, simple,

hook-like, without barbs but with a concave cutting edge. Galeala (galeal seta) curved, pointed, lightly ciliated, 20μ long. Hypostomal lip present, delicate, fimbriated. Anterior hypostomala simple, pointed, curved, 17μ long. Posterior hypostomala pointed, ciliated, 46μ long.

Palpal setal formula 0, 0, 1, 1, 3, 7, i.e. no palpal coxala or trochanterala. Palpal supracoxala present, 3μ long. The claw of the palpal tibia bifid, curving ventromedially, the ventromedial tooth the stronger.

Description of Pupa I (from ACA1060B, supplemented from ACA1060A). Colour red. General shape typical for the erythraeoid pupa I, ovoid, flattened ventrally, notched anteriorly, and with various protuberances, as normal. Length 1200μ, width 1000μ (estimated from the preserved cast skin). The pupa, particularly over the dorsal surface, is provided with a bristly coating of typical pupal setae, mostly projecting posteriorad. Setae 56-130μ long, slender, stiff, nude, swordlike, gradually tapering except in terminal part, which then tapers abruptly to a slightly blunted point; setae provided with the normal papillate basal socket.

Description of Nymph (Figs. 3, 4) (from ACA1060A, freshly emerged, unfed, then dried, finally mounted in polyvinyl alcohol, and possibly slightly compressed from above; also supplemented from ACA1060B). Colour in life red. Length of body to tip of mouthparts (hypostomal lip) 1360μ, width 930μ. External appearance normal for genus, with the usual squarish and lumpy outline.

The standard data are (in micra):

ASens	PSens	SBa	SBp	ISD	DS
118	ca 160*	12	24	490	80—160

* From ACA1060B

Cristal sensillae long, thin, pointed, nude. Anterior end of crista with ovoid boss, about 125μ long by 95μ across; anterior point of boss 86μ ahead of centres of ASens. Boss provided with about 18 scobalae, long, tapering, pointed, with slender projecting barbed ciliations, these being longest basally; setae 160-200μ long. Anterior sensillary area enclosed by the forking anterior arms of the crista, which separate at an angle of about 60°. Posterior sensillary area encloses a transverse ovoid roughened boss.

Eyes 1 + 1, 57μ across, placed well behind mid-cristal point (MCP, or midpoint between centres of bases of ASens and PSens; distance from eye level to MCP 170μ).

Dorsal idiosomalae long, tapering, curved, slender, often sinuous in the slide mount, quite ciliated (more marked basally), 80-160μ long. Setae dense, forming a hairy covering over the body. Venter of idiosoma with similar setae.

Legs as figured, with the normal somewhat beaded and irregular appearance of the genus. Leg I 1345μ long, II 790μ, III 965μ, IV 1470μ (all measured from the distal point of the coxa to the tips of the tarsal claws). Tarsus I 245μ long by 89μ high, tibia I 319μ long. Tarsus IV 153μ long by 72μ high, tibia IV 352μ long. Tarsi with scopulae. Tibial tuberosities present, normal, situated a little beyond middle of segment in tibia I, II, III, but in IV about 3/5 along length of segment. Clear areas with a punctate appearance to the chitin are placed distally and dorsally on some leg segments (such as Vitzthum (1926)

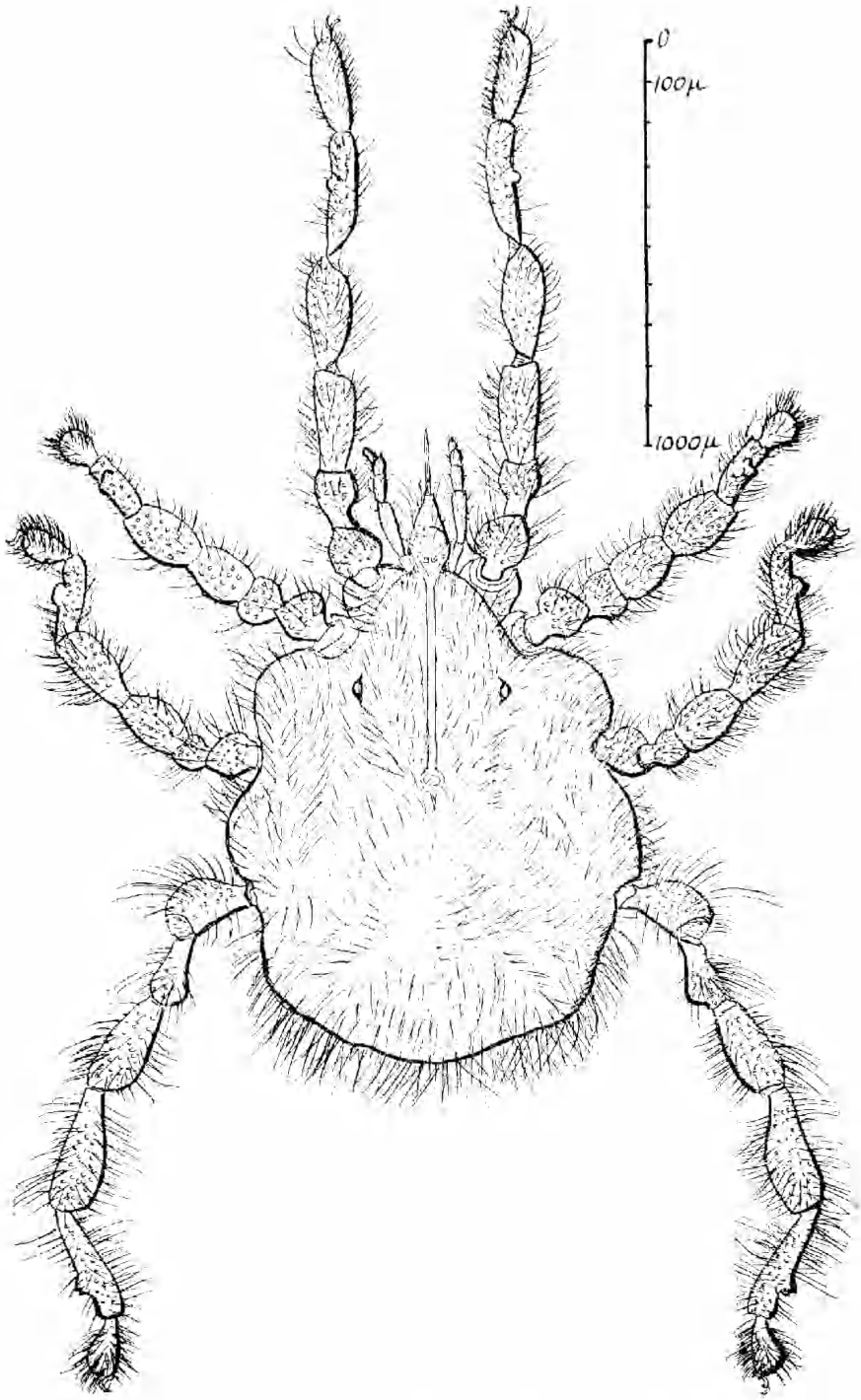

Fig. 3.—*Caeculisoma darwiniense* n. sp. Nymph, entire, dorsal view.

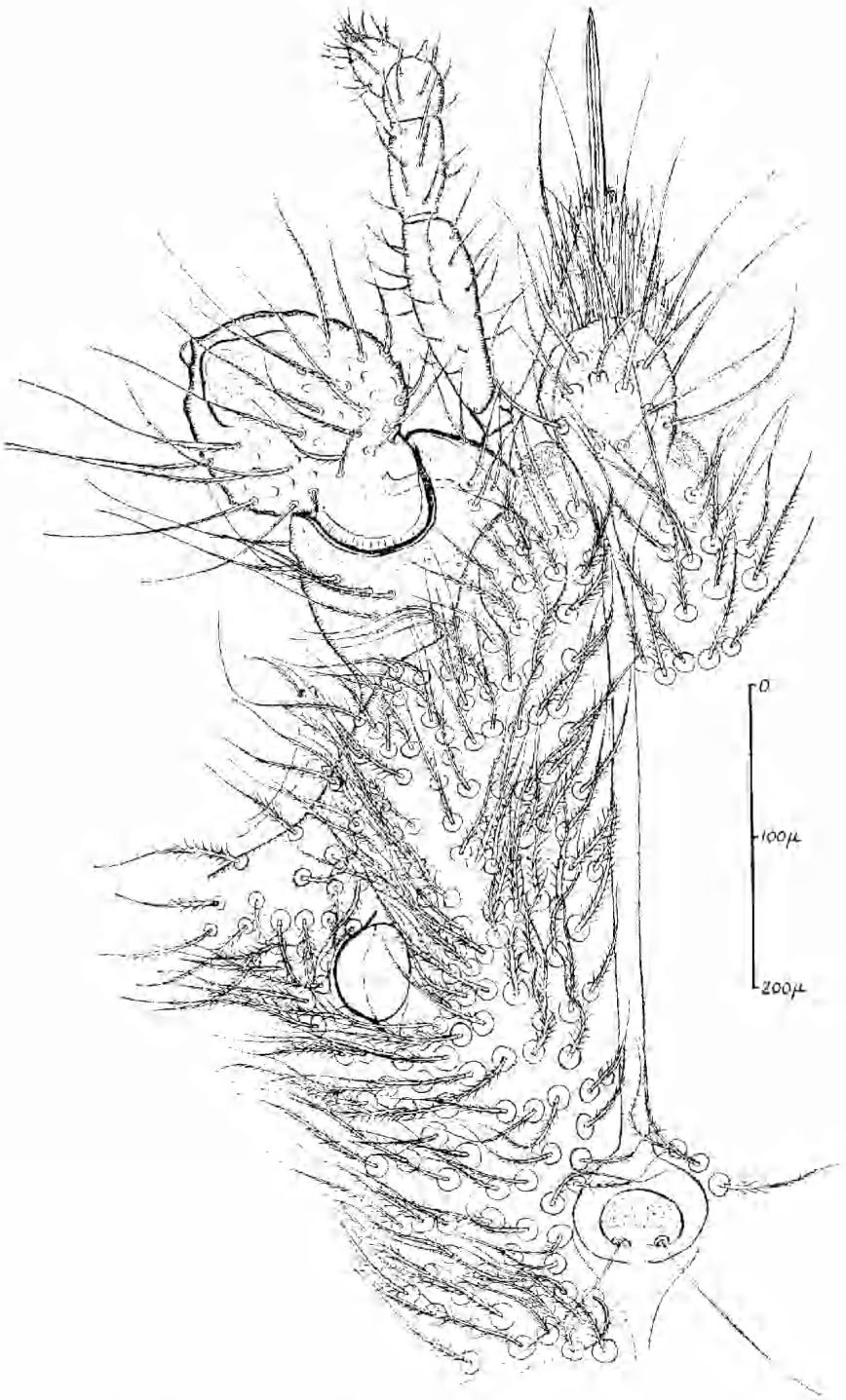

Fig. 4.—*Caeculisoma darwiniense* n. sp. Nymph. Part of propodosoma, including crista and left eye, and adjacent structures.

describes and figures for *C. argus* Vitzthum, 1926, and *C. infernale* Vitzthum, 1926, and Cooreman (1958) figures for *C. afrum* Cooreman, 1958; they are present also in other species of *Caeculisoma* and *Callidosoma* examined by the writer). One such of these is figured dorsodistally upon the trochanter I of the nymph in Fig. 4.* Tarsal claws 2, normal, strong, falciform, simple. Legs thickly covered with setae, the scobalae similar to those on the idiosoma.

Gnathosoma normal, as figured. Palpi as figured, characteristic of the genus (see redefinition by the writer (1961)).

Locality. (1) The type (ACA1062B) and paratype (ACA1062A) were two larvae, captured ectoparasitic upon the external surface of the right hindwing of a locust, in hilly country about 3-4 miles south of Coomalie Creek, Northern Territory, 13 June, 1943 (R. V. Southcott). The host has been identified as *Goniaea* sp. aff. *hyalina* Sjöstedt, ♂, by Dr. K. H. L. Key, Division of Entomology, C.S.I.R.O., Canberra (pers. comm. 11 Nov., 1957).

(2) Another batch of 6 larval mites (ACA1060) was obtained from the same locality, 7 May, 1943, attached to hindwings of a ♀ specimen of *Goniaea* sp. aff. *hyalina* (identified by K. H. L. Key, as above) (R. V. Southcott). All specimens of mites were attached by their mouthparts to veins of the wings, except one specimen which was recorded as "sitting astride a cell" of the wing. This latter specimen could, of course, have been dislodged from some other situation by the trauma of capture and handling.

Biology. The mites were detached from their host in each case, and the host preserved. The mites were transferred individually to clean, dry tubes. Of the eight specimens two subsequently underwent ecdysis to pupa I and nymph. The details of these two successful rearings are as follow:

Specimen	ACA1060A	ACA1060B
Captured and removed	7 May, 1943	7 May, 1943
Became immobile	10 May	7 May
Skin split off	12 May	11 May
Nymph emerged	27 May	22-25 May
Survived until	7-11 June	2-10 June

No attempt to feed the nymphs thus obtained was made. During the experiment the tubes were kept as cool as possible, i.e. by being kept in the shade, but without any special facilities or procedures.

REMARKS ON SYSTEMATICS

(1) Larvae

The definition of the larva of *Caeculisoma* Berlese, 1888, has been given by the writer elsewhere (Southcott, 1961). That definition was based on the species described above, *C. darwiniense* n. sp., and its experimental rearing from larva to nymph. From a study of those larval Callidosomatinae that have previously been described it is apparent that no larvae of *Caeculisoma* have been described hitherto. The species *C. darwiniense* n. sp. is based upon the larva as type, but as there are no other published accounts of larval *Caeculisoma* its systematic position within the genus must depend upon the characters of the nymphal stage reared (see below). The writer has seen a number of unde-

* The tibial tuberosities have the same punctate chitin and it is apparent that the tibial tuberosities are homologous structures. Probably they serve as chemical sense organs, and not as organs of ocular function, as Vitzthum suggested.

scribed species of larvae of *Caeculisoma* and other genera of the Callidosomatinae ectoparasitic upon Australian locusts, grasshoppers and other insects, which it is hoped to describe formally later, and to make appropriate comparisons.

(2) Adults and Nymphs

Cooreman (1958) has reviewed the species of *Caeculisoma* of the world, listing the important systematic characters of each species. Including his *C. afruum* Cooreman, 1958, the total of described adults (or possibly nymphs) amounted to 10 species. Among these 10 species the dorsal idiosomal setae are of diverse character, e.g. having been recorded as expanded, clavate, cylindrical, asparagus-tip-like, etc., but in none does the dorsal setation resemble that of *C. darwiniense* n. sp., where such setae are of a single kind, uniform in character over the dorsum, being long, flexible, pointed, tapering and ciliated.

There is, however, one species of the genus which has been recorded from Indonesia and New Guinea, *Caeculisoma sulcatum* (Canestrini, 1898),* where some further comment is required. Of *C. sulcatum* Cooreman (1958, p. 45) states: "Les poils de l'idiosoma sont de deux types: les uns portent quelques ramifications latérales, les autres sont simples, lisses et rigides, quoique progressivement effilés distalement; ces derniers sont d'ailleurs aussi plus longs que les autres". Originally Canestrini had described a species *Rhyncholophus sulcatus* in 1898 and 1899.* His description of the setae (1898, p. 481) was: "Corpo vestito di setole cigliate; arti pure coperti di setole cigliate, fra le quali se ne osservano alcune rare assai sottili e semplici che sono piantate sull'arto ad angolo quasi retto". The specimen came from Erima, Astrolabe Bay, New Guinea. Unfortunately the remainder of the description is also brief, and Canestrini provided no figures. Vitzthum (1924, pp. 357-9) redescribed this species from Krakatau Island, Sunda Islands, Indonesia, placing it in *Belaustium* (sic). In 1926 (pp. 168-9) he referred again to this species, placing it in *Caeculisoma*, and again stated (p. 169) his belief that his specimen from Krakatau was identical with Canestrini's species: "Auch heute noch glaube ich an der Identität der Art mit Canestrinis *Rhyncholophus sulcatus*. Denn Canestrinis Beschreibung passt Wort für Wort auf sie. . . ." (apart from one point

* Some doubt attaches to the dates 1898 and 1899 of Canestrini's two articles. These dates will be used here as given by the writer in his monograph on the genera of the Erythraeoidea (1961), following Vitzthum (1924, 1926). The writer has not seen the second of these two papers by Canestrini ("1899"). Vitzthum (1924, 1926) had, however, seen both papers, referring to the pagination of the second paper from a reprint. As Vitzthum provides (1924, p. 357) a translation of Canestrini's description in Italian into German, corresponding to Canestrini (1898) as used here, the present writer assumes that his "1899" paper contains at least no further descriptive material relating to his *Rhyncholophus sulcatus*. (N.B.: In 1924 Vitzthum dated both of these papers as "1898".) A minor further point is that it is possibly surprising that Canestrini did not place *Rhyncholophus sulcatus* immediately in *Caeculisoma*, since he had earlier (1897) described a species of mite from New Guinea as *Caeculisoma claviger* Canestrini, 1897. Cooreman (1958) has amended the specific name to *clavigerum*, presumably correctly, since Canestrini was probably using *claviger* as an adjective and not as a substantive, and has remarked that *C. clavigerum*, which was unfortunately originally very briefly described without figures, has not been recorded subsequently. However, the present writer has in his own collection five specimens of *Caeculisoma* from the Aitape-Wewak area of New Guinea which answer to Canestrini's description. Locality records of these are: 3 specimens, Babiang, 22 December, 1944 (ACA1619, 1620, 1621); 2 specimens, Suam, 15 February, 1945 (ACA1622, 1623). All specimens were collected in leaf-litter and humus on the forest floor, near the coast (R. V. Southcott). Possibly two species are present among these five specimens. It is hoped to refer to this material further in a later paper.

in the description of the palp where he believed Canestrini was in error). The present writer believes that this viewpoint of Vitzthum on the identity of the species may be accepted.

Vitzthum (1924, p. 359) stated of the setation of his Krakatau specimen: "Die Behaarung des Rumpfes die in der Abbildung [of Vitzthum] weggelassen ist, ist sehr dicht and besteht in feinen, weichen, mässig kurzen, beiderseits spärlich gefiederten Haaren, die den gefiederten Haaren der Beine durchaus gleichen. Einen besonderen Radiationspunkt, wie in der Gattung *Leptus* Latreille, 1795,* zeigen diese Rumpfhaare nicht". As he stated, he did not figure the dorsal idiosomal setae, but he did figure (his Fig. 4 on p. 359) the leg setae, which were mostly similar to the dorsal idiosomal setae, but included also some more outstanding simple spiniform setae. It is apparent that Cooreman has taken these latter as being present also upon the idiosoma, which is in fact not stated by Canestrini or by Vitzthum. Womersley (1934, p. 241) in his key to the genus *Caeculisoma* has made a similar error.

Neither Canestrini or Vitzthum gave any measurements of the lengths of the dorsal idiosomal setae in *C. sulcatum*, although Vitzthum (1924) described them as short. On a comparative basis the present writer would consider the dorsal idiosomalae of *C. darwiniense* as long, which is a fair description of setae 80-160μ long among the Erythraeoidea and Trombidioidea. The ciliated leg setae of *C. sulcatum*, as described and figured by Vitzthum (1924), and which he states are the same as the dorsal body hairs of the same species, are obviously different in character from those of the *C. darwiniense* nymph. Those of *C. sulcatum* are from Vitzthum's Fig. 4 fairly short, and carry only 4-6 ciliations throughout their length. In *C. darwiniense* nymph the dorsal idiosomalae are long, tapering gradually, heavily ciliated, particularly basally, and the usual leg scobalae have the same character.

There are also other differences which may be noted between *C. darwiniense* and *C. sulcatum* (Canestrini) Vitzthum. In the two nymphs of *C. darwiniense* available the posterior projection of the crista behind the posterior sensillary area appears to be comparatively short, but unfortunately pigment within the specimens prevents much study of that feature. In *C. sulcatum* the posterior process is of great length, being almost as long in Vitzthum's specimen as the remainder of the crista (see 1924, p. 358, including his Fig. 3). However, this point is not stressed here, since this feature is not necessarily comparable between a nymph and an adult (Vitzthum stated his specimen was an adult). Another difference between these two species, undoubtedly of specific significance, lies in the leg structure, going on Vitzthum's Fig. 3 (1924, p. 358). Thus in *C. darwiniense* the legs are more irregular in outline, and the tarsi of the legs comparatively shorter, at least in leg II.

REMARKS ON THE BIOLOGY AND GEOGRAPHICAL DISTRIBUTION OF *CAECULISOMA*

Adults or nymphs of this genus are terrestrial predators, being found in humus, leaf-litter, under bark and other similar situations. The larva recorded in this paper was taken parasitic upon a locust, and the writer has seen other Australian larval species of *Caeculisoma*, at present undescribed, taken ectoparasitic from other Australian locusts and grasshoppers.

* Accepted now as 1796. See Southcott (1961).

At the present time, recorded specimens of the genus are distributed geographically as follows:

South America - - -	*C. tuberculatum* (Berlese, 1888).
Marquesas Islands - -	*C. cordipes* Vitzthum, 1935.
Africa - - - - -	*C. afrum* Cooreman, 1958.
New Guinea, Sunda Islands -	*C. sulcatum* (Canestrini, 1898).
New Guinea - - -	*C. clavigerum* Canestrini, 1897.
Sumatra - - - -	*C. argus* Vitzthum, 1926.
	C. infernale Vitzthum, 1926.
Australia - - - -	*C. montanum* (Rainbow, 1906).
	C. nasutum Hirst, 1928.
	C. johnstoni Womersley, 1934.
	C. darwiniense n. sp.
	C. argus ssp. *io* n. ssp.*

This wide geographical distribution of the genus has been commented on by previous writers; most recently by Cooreman (1958), who has pointed out that all specimens recorded so far have come from the southern hemisphere, between 0° and 40° S. latitude. Such a wide geographical dispersion could at least in part be explained on the hypothesis that they are spread, or have been, by larvae parasitic upon hosts which themselves have considerable powers of dispersion, e.g. by flight or other means. It would appear that locusts and grasshoppers could fulfil such a requirement. The extent to which these larval mites are host-specific requires further study. Some Erythraeoid larvae have so far been found only upon a restricted host range, while others have a wider range. Thus *Smaris* (Smarididae) larvae have so far been found only upon Psocoptera, while within one genus, e.g. *Erythrites* (Erythraeidae), one species may be restricted, thus *Erythrites osmondensis* (Southcott, 1946) has been found only upon Thysanoptera, while other species, such as *Erythrites reginae* (Hirst, 1928) and *Erythrites urrbrae* (Womersley, 1934) will parasitize a wide range of insects (Womersley and Southcott (1941); Southcott (1946, 1960)).

REMARKS ON THE LIFE HISTORY OF THE ERYTHRAEOIDEA

It is proposed to make some comparisons of the durations of the stages in the life histories of various Erythraeoidea. Such data are now available for a number of Australian species of both the families Erythraeidae and Smarididae. Details of the durations are given in Table 1.

---

* Based upon a specimen from Glen Osmond, South Australia, January, 1934 (R. V. Southcott) and recorded by Womersley (1934, p. 238) as *C. argus* Vitzthum. A restudy of that specimen shows that it has considerably shorter setae than *C. argus* f. p. from Sumatra and the following new subspecific name is proposed for it: *C. argus* ssp. *io* n. ssp. In *C. argus io* the dorsal idiosomal setae are 20-136μ long and the scobalae of the anterior sensillary area are 76-131μ long, as against the figures given by Vitzthum of 35-190μ for the idiosomalae and 190μ for the scobalae of the anterior sensillary area in *C. argus* f. p.

My field notes for the type specimen (ACA1641) of *C. argus io* record it as being collected "very early in January, probably 1st" January, 1934 "on surface of water in a horse [and cattle] trough (Trough A)" at Glen Osmond. That trough was one of the three upon which specimens of *Speleognathus australis* Womersley, 1936, were collected by myself over 1934-1941, as noted elsewhere (Southcott, 1957). The map reference for the site of Trough A is 656808 Map Adelaide 1:63360 No. 810 Zone 6 Sheet South 154M/ IV SE & SW. The trough has now been removed for several years. Over the years it was under study it was placed in contact with the ground, under the shade of a sugar gum, *Eucalyptus cladocalyx*, one of some rows that had been planted in about 1895, according to Gill (1905, p. 5). It was found that frequently insects, such as flies, hymenoptera, and collembola, were blown onto the water surface or otherwise occurred there, also mites, etc. Presumably most of these came from the surrounding vegetation. It would appear probable that the *Caeculisoma* was blown in from the foliage of the *Eucalyptus cladocalyx* above.

An inspection of Table 1 indicates that over the instars pupa I to pupa II, as well as the immobile stage immediately before pupa I, the durations of the stages or instars are broadly comparable over the species studied in the two families. These data have all been obtained with Australian Erythraeoidea in experiments conducted by the writer, all being in the Adelaide region of South Australia with the exception of *Caeculisoma darwiniense*, which was conducted in the Darwin region of the Northern Territory. No comparable data exist for other Erythraeoidea elsewhere in the world, and in fact for the fauna of other parts of the world only fragmentary data on life-history are available (see Southcott, 1961).

TABLE 1.

Durations of the stages of Erythraeoidea, in days.

	Prepupal immobile stage	Pupa I	Nymph	Pupa II
*Erythrites reginae**	2, 3, 2	12, 13, 12	21	15
*Erythrites osmondensis**	2	9		
*Erythrites pilosus**	3-4	11-12		
*Erythrites urrbrae**	2, 2, 4, 2, 1-2, 1-2, 1-2, 1-2, 1	13, 15, 14, 12, 15-16, 14-15, 15-16, 16	39, 11+, 21+, 13+, 25	16, 15
*Erythroides clavatus**	7, 3	12		
*Rainbowia imperator***	6, 4, 6, 4, 4, 4, 6, 5, 5	28, 27+, 58, 45, 25-26, 23-24, 22, 26, 27, 18		
*Callidosoma womersleyi**	4, 2	9, 12		
Caeculisoma darwiniense	2, 4	15, 11-14		
Pollux sp.* (ACA882B)	6	9		
*Smaris prominens****	3-7, 7-9, 4-5	27-30, 21-24, 35, 31-51+	80+	

* Data from Southcott (1946)
** Data from Southcott (1961)
*** Data from Womersley and Southcott (1941).

A closer inspection of Table 1 shows, however, that two main groups can be separated, thus:

Class I, the "fast group". These have a prepupal immobile stage of in general 1-3 days, a pupa I stage of the order of 9-16 days. The group includes species listed belonging to the genera *Erythrites, Erythroides, Callidosoma, Caeculisoma* and *Pollux*.

Class II, the "slow group", have a prepupal stage of the order of 4-6 days (the range extending occasionally over 3-9 days) and a long pupa I stage last-

ing on an average about 30 days, and ranging over 18-58 days. This group so far includes only *Rainbowia imperator* (Hirst, 1928) (family Erythraeidae) and *Smaris prominens* (Banks, 1916) (family Smarididae).

We may then ask whether these two classes correspond to other biological features in the Erythraeoid mites. Table 2 shows a table of the seasonal incidences of the various instars of mites of the Erythraeoidea where there is sufficient knowledge available to list the seasonal incidences of these instars. This last condition restricts the table to species occurring in temperate Australia, in fact, most of it is derived from observations made by the writer on the fauna in the Adelaide region of South Australia (using the same sources as given in the footnote to Table 1, and in addition Southcott (1960)).

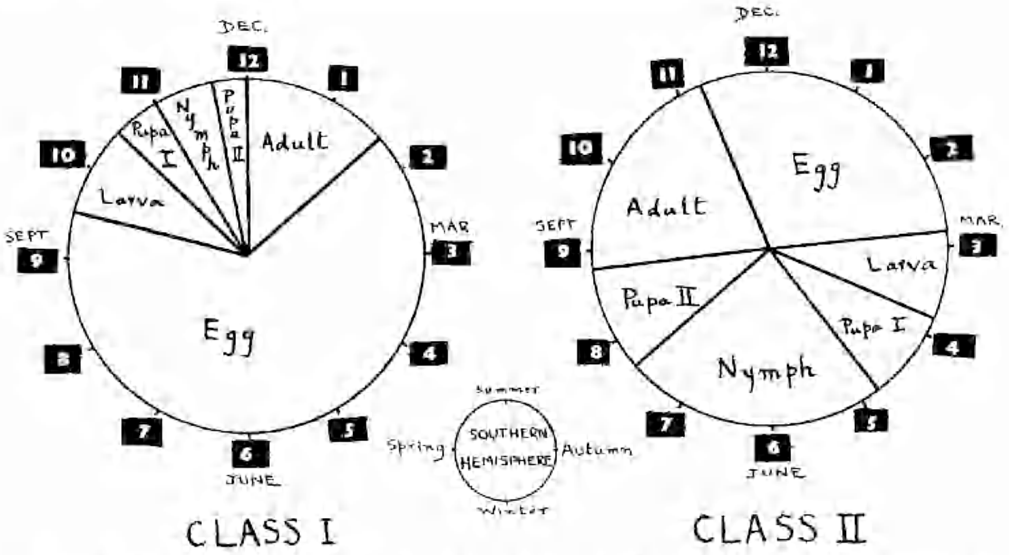

Fig. 5.—Diagram to illustrate the two broad classes of life history in the Erythraeoidea. The numbers represent the months of the year, by their ordinal number. For class II the diagram is interpretative for pupa II, as precise data are not available for that instar.

As will be observed from the data in Table 2, the larvae have in each case a limited seasonal distribution. Inspection of the seasonal distributions of the larvae shows that they are classifiable into two groups: those occurring over September to February (exceptionally into March), i.e. spring-summar larvae (genera *Erythroides, Erythrites, Callidosoma, Pollux*), on the one hand, and on the other those with larvae occurring in March to June (*Smaris, Sphaerotarsus, Rainbowia*).

Thus it is found that again we have segregated the same genera as by our previous classification of the durations of the instars and stages. The following two classes may therefore be proposed:

Class I: the long-duration-egg group, with spring larvae and summer adults, the non-egg developmental stages being passed through quickly. About 2/3 of the annual cycle is passed in the egg. Examples *Erythrites, Erythroides, Callidosoma, Caeculisoma, Pollux, Microsmaris* (all family Erythraeidae).

Class II: the short-duration-egg group, with autumn larvae and spring adults, the non-egg developmental stages being passed through more slowly. About 1/3 of the annual cycle is passed in the egg. Examples *Rainbowia* (family Erythraeidae), *Smaris, Sphaerotarsus* (family Smarididae).

TABLE 2.

Table of seasonal incidences of Erythraeoidea instars and species for temperate Australia.

Mite	Adult	Egg	Larva	Pupa I	Nymph	Pupa II
Smaris prominens	All year, maximal Apr.-June	Mar.-(May)	Mar.-May	Apr.-June	Apr.-Oct., maximal Apr.-May	
Sphaerotarsus leptopilus	Dec.-Mar.	Feb.-Apr.	Apr.-June			
Rainbowia imperator	July to early Dec.	Oct.-Mar.*	Mar.-May	Apr.-May	May-Sept.	
Erythroides clavatus	Aug.-Jan., especially Nov.-Jan.**		Nov.-Dec.	Nov.-Dec.	Nov.-Dec.	
Erythrites reginae	Nov.-Mar.	Dec.-Mar., exceptionally Sept.-Nov.	Sept.-Nov.	Nov.-Dec.	Nov.-Dec.	Dec.-Jan.
*Erythrites osmondensis***			Sept.-Nov.	Nov.	Nov.-Dec.	
*Erythrites guttatus****	Nov.-Jan	Jan.				
Erythrites pilosus	Jan.-Aug., mainly autumn	May-Dec.	Nov.-Mar.	Nov.-Dec.	Dec.,**** Apr.-May	
Callidosoma womersleyi	Dec.		Dec.-Feb.	Dec.-Jan.	Dec.-Jan.	
Pollux sp. or spp.	Nov.-Feb.*****		Nov.-Dec.	Nov.-Dec.	Nov.-Dec.	

* Based on the time of emergence of the larvae.
** Assuming that *Erythroides clavatus* is the larva of either *E. neoserratus* or *E. serratus*, which is probable.
*** Probably conspecific.
**** Based on experiment ACA863 (see Southcott 1946).
***** Assuming, as appears probable, that the adults and nymphs previously classified as *Microsmaris* are the adults of *Pollux* (see Southcott 1946, 1961).

Although there are variations from the basic classification proposed, e.g. in the fact that adults of *Smaris prominens* may be found throughout the year, or that *Erythrites pilosus* adults appear over January to August and the eggs over May-December, it is apparent that there is a broad separation into the two classes proposed. An attempt to show these two broad groups in a generalized way is made in Fig. 5, where the months of the year are represented by their ordinal numbers as in a conventional 12-hour clockface, thus January by 1, February by 2, and so on. For the southern hemisphere, therefore, summer will be represented at the top of the circle and winter at the bottom. Autumn will be at about 3 o'clock and spring at about 9 o'clock. In the northern hemisphere the reverse would be the case by the same clockface convention.

In Table 2 the details of *Caeculisoma darwiniense* were not shown, since the species has so far been recorded only from northern Australia, and only limited collecting could be done there over May-June, and no information is available as to the possible seasonal occurrence of the species in other months; furthermore, the seasonal temperature differences over the year are different from those of southern Australia, there being no cold season.

REFERENCES*

Canestrini, G., 1897. Nuovi Acaroidei della N. Guinea, Termés. Füzetek, **20**, pp. 461-474.

Canestrini, G. (?1898). Nuovi Acaroidei della N. Guinea (Terza serie), Termés Füzetek, **21**, pp. 480-487.

Canestrini, G. (?1899). Acari della Nuova Guinea, Atti Soc. Veneto-Trent. Sci. nat. (2), **3** (2), ca p. 397 (not seen).

Cooreman, J., 1958. Acariens du Congo Belge (2e série). Note sur le genre *Caeculisoma* Berlese, 1888 (Acari, Erythraeidae) et description d'une espèce nouvelle du Congo Belge, Rev. Zool. Bot. Afr., **58** (1-2), pp. 43-53.

Gill, T., 1905. History and Topography of Glen Osmond. Pp. vi and 1-161. Adelaide, Vardon and Pritchard, Printers, Gresham Street.

Newell, I. M., 1957. Studies on the Johnstonianidae (Acari, Parasitengona). Pacific Science, **11** (4), pp. 396-466.

Southcott, R. V., 1946. Studies on Australian Erythraeidae (Acarina). Proc. Linn. Soc. N.S. Wales, **71** (1-2), pp. 6-48.

Southcott, R. V., 1957. Description of a New Australian Raphignathoid Mite, with Remarks on the Classification of the Trombidiformes. Proc. Linn. Soc. N.S. Wales, **81** (3), pp. 306-312.

Southcott, R. V., 1960. Notes on the Genus *Sphaerotarsus* (Acarina: Smarididae). Trans. Roy. Soc. S. Aust., **83**, pp. 149-161.

Southcott, R. V., 1961. Studies on the Systematics and Biology of the Erythraeoidea (Acarina), with a Critical Revision of the Genera and Subfamilies. Aust. J. Zool. (in press).

Vitzthum, H. G., 1924. Die heutige Acarofauna der Krakatau-Inseln. Treubia, **5**, pp. 353-370.

Vitzthum, H. G., 1926. Malayische Acari. Treubia, **8**, pp. 1-198.

Womersley, H., 1934. A Revision of the Trombid (sic) and Erythraeid Mites of Australia with Descriptions of New Genera and Species. Rec. S. Aust. Mus., **5** (2), pp. 179-254.

Womersley, H., and Southcott, R. V., 1941. Notes on the Smarididae (Acarina) of Australia and New Zealand. Trans. Roy. Soc. S. Aust., **65** (1), pp. 61-78.

* Principal references only are given here. A full bibliography of the genus *Caeculisoma* is given by Cooreman (1958) and Southcott (1961), the latter containing a full bibliography of the Erythraeoidea.